Title:
Application of a fungal pathogen for the management of ticks in a county park, Suffolk County, NY. NYS IPM Program 2004.

Project Leaders:
Jody Gangloff-Kaufmann, NYS IPM Program
Joyce Rodler, CCE Suffolk County
Thomas Corell, Earth BioSciences, Inc.

Cooperators:
Robert Serino, CCE Suffolk County
Sadie Puglisi, formerly of CCE Suffolk County
Suffolk County Department of Parks and Recreation

Project locations:
Project was conducted in a county park with Pine Barrens habitat in Suffolk County, NY, and results could be extrapolated to areas of the Northeastern US with a similar climate and ecological habitat infested with Lone Star ticks (*Amblyomma americanum* Linnaeus), blacklegged ticks (*Ixodes scapularis* Say), and American dog ticks (*Dermacentor variabilis* Say).

Abstract:
Ticks and tick-borne diseases are of common concern in New York and especially on Long Island, where Lyme disease and an invasive new species of tick, the Lone Star tick, are endemic. Pesticide alternatives are being sought for the management of ticks in sensitive ecological areas, recreational areas, homes, and municipalities, where limits or bans on pesticide use are in place. Biological control using fungi for tick management has shown promising results in previous studies. This experiment was designed to test a commercial formulation of a fungal insecticide/acaricide for use in the management of ticks in the landscape. Results suggest that the emulsifiable concentrate formulation tested can be used to reduce tick numbers in the landscape, for up to three weeks post-treatment.

Background and justification:
On Long Island, specifically in Suffolk County, ticks infest many public and private lands, often rendering them unusable due to the risks of infection from Lyme and related diseases. While public awareness of blacklegged ticks and the transmission of disease is adequate, the less well-known Lone Star tick has become the dominant species in some habitats in the Northeast. Like the blacklegged tick the Lone Star tick is carried by deer, small mammals, and birds, and it can vector Lyme disease. However, unlike the blacklegged tick, the Lone Star tick is tolerant of dry summer conditions and tends to spread into grassy areas, including athletic fields and home lawns, in locations where deer are present. Many students at Suffolk County Community College, Riverhead, NY, have reportedly complained about being infested with dozens of nymphal ticks, after walking across campus. These ticks were identified as Lone Star ticks and because the campus is home to numerous deer, the risk of Lyme disease

transmission is clear and tick management is desirable for parts of the campus with high foot-traffic.

In 1999 Suffolk County began to implement a pesticide phase-out that includes a ban on pesticides normally used against ticks. Testing alternatives to pesticides is a high priority for Suffolk County. Tick-Ex is a biological acaricide containing spores of entomopathogenic *Metarhizium anisopliae*. This product is not registered in New York State and therefore the group decided to conduct an experiment that would test the impact of Tick-Ex on ticks in a real-life setting, as well as provide needed data that may support the registration of this product in New York. This project was a cooperative effort among CCE of Suffolk County, NYS IPM and Earth BioSciences, Inc., the makers of Tick-X a fungal product for tick management.

Objectives:

1. Test whether Tick-X EC (emulsifiable concentrate of *Metarhizium anisopliae*) is effective at labeled rates for the management of three tick species in Suffolk County.

2. Test whether Tick-X G (granular formulation of *Metarhizium anisopliae*) is effective at labeled rates for the management of three tick species in Suffolk County.

Procedures:

To test whether Tick-Ex EC and G are effective for management of ticks, a location was chosen in a Suffolk County Park, near buildings, walkways and human activity that was completely inundated with all life stages of Lone Star, black-legged and to a lesser extent, American dog ticks. The area chosen was a combination of dry grassy habitat adjacent to pine barrens-type wooded understory. Lone Star ticks were the dominant species, followed by blacklegged ticks. Deer were present in great numbers.

Plot sizes and locations were determined by recommendations from other ticks management studies and the amount of useable space available to the researchers that was infested with ticks. Plot sizes were approximately 164 feet long by 20 feet wide, along pathways between buildings. Sampling was performed using drag mats constructed of 3'x3' swatches of white cotton flannel attached to a pair of wooden dowels. Mats were dragged through the length of the plot in 2 thirty-second passes and tick numbers were counted and recorded. Each plot was assigned a devoted drag mat to avoid cross-contamination of spores into untreated areas. Initial scouting was done three times in June, before treatments were applied, in order to assess the levels of infestation of each plot and for comparison of the percent change in population in each plot after treatment. Tick numbers varied among plots, but all had sufficient numbers of ticks to support an experiment. Plots were grouped by level of infestation, high, medium, or low to reduce variability.

Applications were made on July 8, 2004. There were 3 replications each of 3 treatments, for a total of 9 plots. Treatments included the application of: 1. Tick-

Ex EC (emulsifiable concentrate) at a rate of 155ml of formulated product in 2845 mL water per plot applied with a hand pump sprayer; and 2. Tick-Ex G (granular) at a rate of 3 pounds of product per plot applied with a hand held spreader. The control plots received no treatment.

Plots were sampled and ticks were collected 1, 2 and 3 weeks after treatment of the plots, counted, recorded, and then placed individually into incubation containers to observe possible infection by fungal pathogens. Mortality and evidence of fungal infection was recorded, although confirmation of fungal species was not possible at the time.

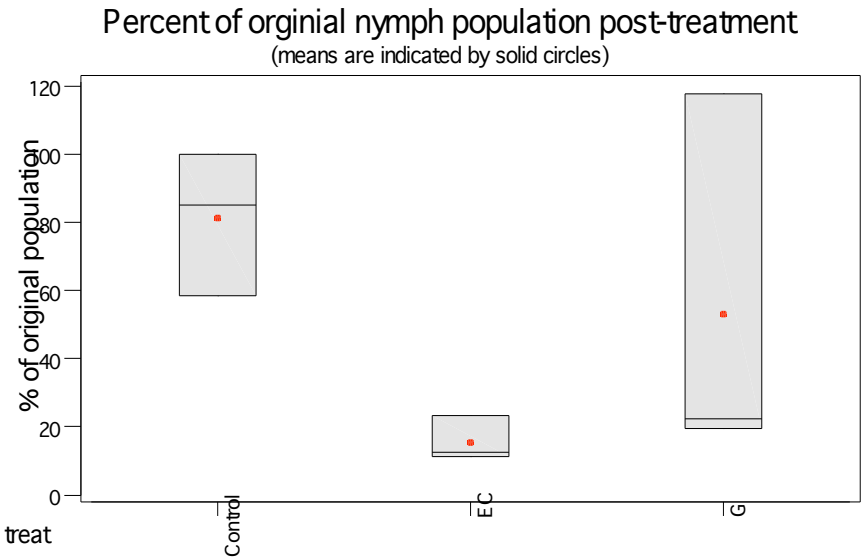
Results and discussion:

Tick captures:

Tick capture data were analyzed using ANOVA (Minitab, Inc.) by calculating the average tick numbers after treatment (three collection dates averaged) as a percent of the average tick numbers before treatment (three collection dates combined) and comparing these figures among treatments. Different comparisons were done for nymph and adult ticks, but results were combined for all species due to the low numbers of blacklegged and American dog ticks captured.

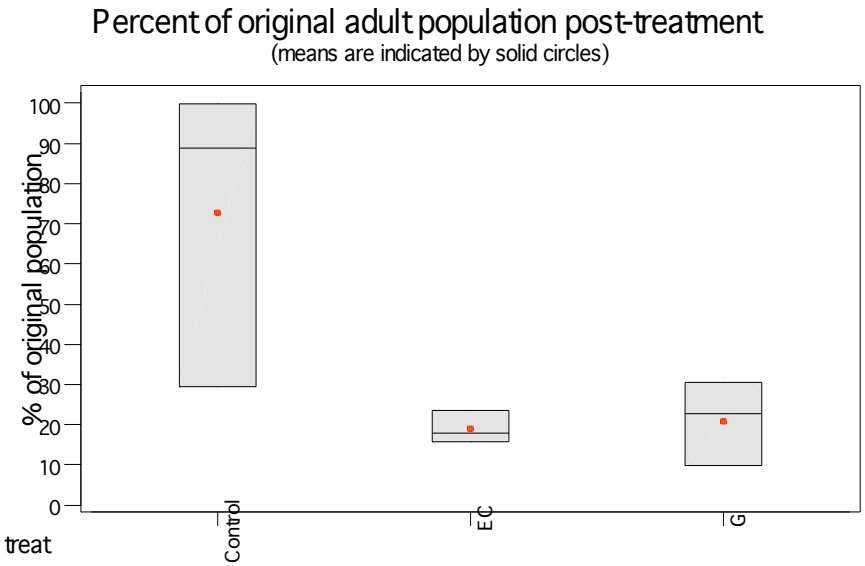
Analysis of nymph ticks captured:
Percent of original population (pre-treatment) of nymphs 1-3 weeks post-treatment

Level	N	Mean	StDev
1 Control	3	81.19	21.12
2 EC	3	15.54	6.55
3 G	3	53.19	56.03



Analysis of adult ticks captured:
Percent of original population (pre-treatment) of adults 1-3 weeks post-treatment

Level	N	Mean	StDev
1 Control	3	72.82	37.96
2 EC	3	19.01	4.02
3 G	3	20.84	10.51



The number of ticks collected post-treatment was significantly lower in samples taken from plots treated with Tick-Ex EC than the control for both nymphs and adults, suggesting that Tick-Ex EC is effective in reducing overall tick numbers in a field setting for up to 3 weeks post-treatment. Significant differences were not recorded for the Tick-Ex G formulation for nymphs and results were barely significant for adult ticks. There were suspected problems with the granular formulation due to mold spores coming off the granular substrate before application. This may have resulted in lower than expected numbers of spores being applied into the test plots and therefore lower efficacy.

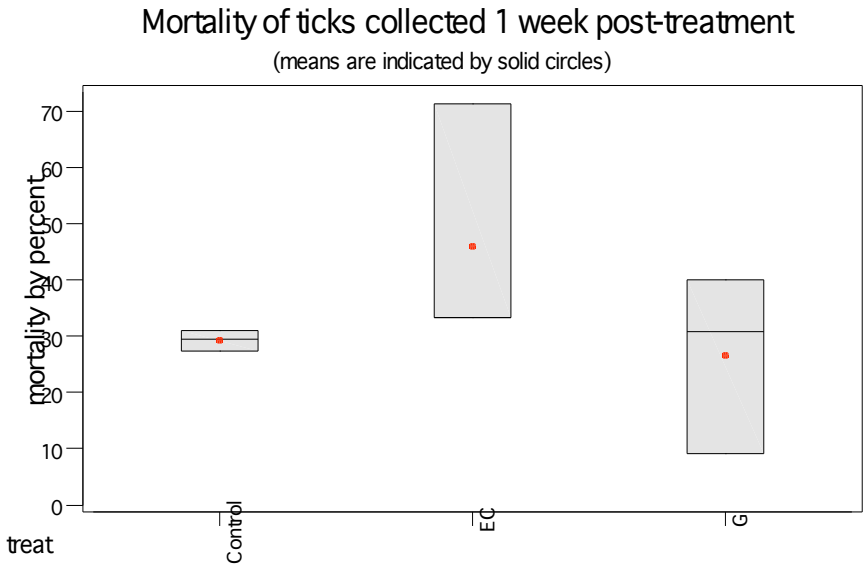
Tick mortality post-treatment:

Ticks collected and counted during the experiment were brought to the laboratory and placed individually into incubation containers (1oz condiment containers with lids) with a paper disc and a drop of water to maintain humidity. These containers were held at about 80 degrees F for up to 28 days and monitored for mortality and development of fungal infections. Mortality and infection values are cumulative for the 28-day incubation period.

Evaluations:

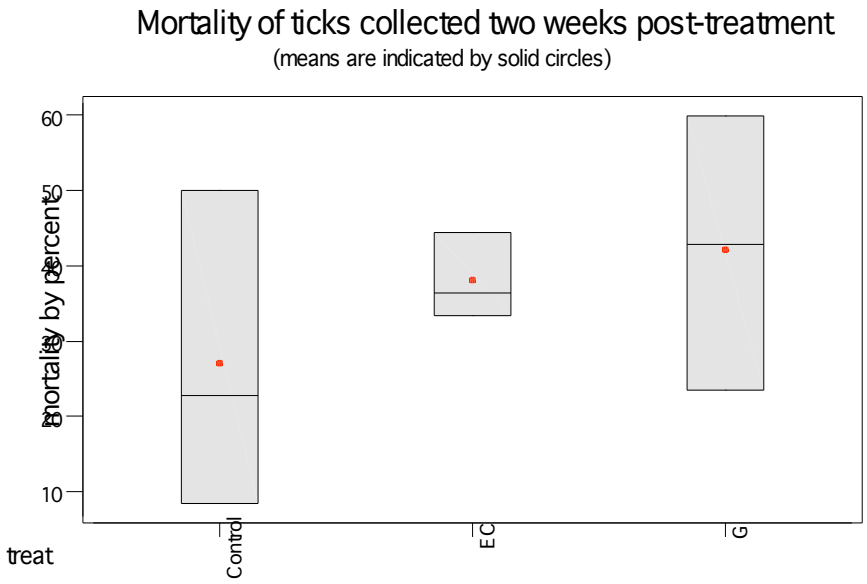
Mortality of ticks collected 1 week post-treatment as a percent of total ticks collected in each plot:

Level	N	Mean	StDev
1 Control	3	29.23	1.87
2 EC	3	46.03	22.00
3 G	3	26.62	15.87



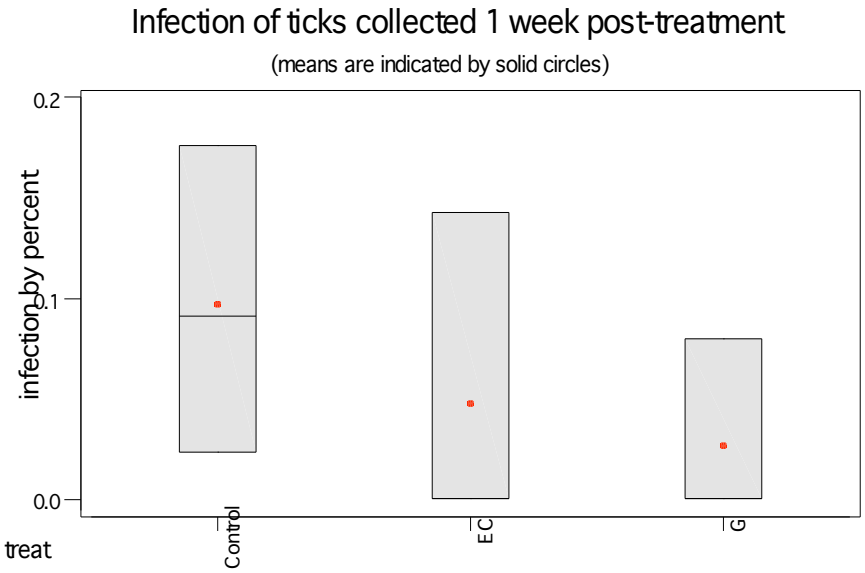
Mortality of ticks collected two weeks post-treatment as a percent of total ticks collected in each plot:

Level	N	Mean	StDev
1 Control	3	27.02	21.16
2 EC	3	38.04	5.74
3 G	3	42.09	18.31



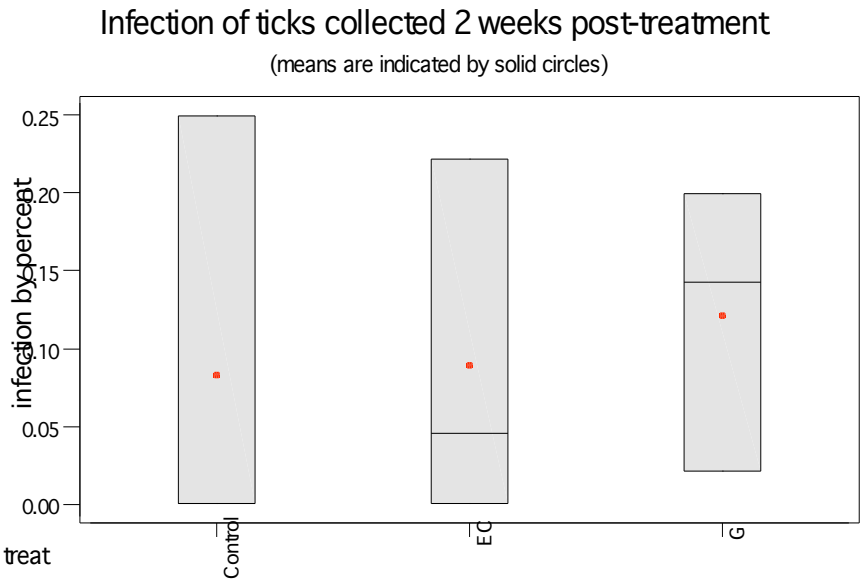
Evidence of fungal infection of ticks collected 1 week post-treatment as a percent of total ticks collected in each plot:

Level	N	Mean	StDev
1 Control	3	0.0969	0.0768
2 EC	3	0.0476	0.0825
3 G	3	0.0267	0.0462



Evidence of fungal infection of ticks collected 2 weeks post-treatment as a percent of total ticks collected in each plot:

Level	N	Mean	StDev
1 Control	3	0.0833	0.1443
2 EC	3	0.0892	0.1174
3 G	3	0.1214	0.0913



Mortality of ticks collected and incubated in the laboratory for observation of infection showed no significant differences among the plots. Overall mortality in incubated ticks was low for all treatments. It is possible that ticks collected one week post-treatment may have avoided infection and were still active in the plots, while infected ticks were not collected. Additionally, humidity and temperature control for this experiment was crude, and may not have encouraged good incubation of fungal infections.

Conclusions:

The use of biological agents, such as pathogenic fungi, for the management of ticks is promising and desirable for those who seek alternatives to pesticides. This work is a small part of the overall effort to improve the efficacy of such products and bring them to market. Correcting problems with the granular formulation may improve its efficacy. If efficacy can be improved in the granular formulation, this could be a popular product due to the ease of application by homeowners and landscapers. Increased use of such biological pesticides can result in reductions in pesticide use by homeowners and landscapers, as well as municipalities, thereby reducing risks to public health and possibly drinking water, streams and other surface waters. Risks from Lyme disease and other diseases may also be lowered as a result of the successful use of fungus for tick management.